EDITORIAL NOTES

Textbooks in Arithmetic and Drawing

Arithmetic-makers are in trouble. They are in the same predicament in which the makers of drawing-books found themselves a few years ago. Drawing began in the schools with a textbook. In this there were sundry forms and figures which were to be copied by the pupil upon blank pages. With the introduction of objects, a new and different demand for drawing arose, and the flat copy drawing-book dropped out. The textbook-makers and their publishers struggled on for a time to make themselves useful; but with the development of nature-study, and other subjects which offered directly a rich fund for art work, even their best efforts, embodying beautiful productions in color and form, availed nothing.

Machine-Made Arithmetics

The machine-made arithmetic is just on the outer confines of the same limbo. The necessity for quantitative work in the study of material things is slowly — very, very slowly — becoming apparent. To the teacher who has the insight to see this necessity, and the skill to meet it in teaching the children, the machine-made textbook in arithmetic, except as a work of reference, is useless.

Use of Type-Forms

When drawing shifted from the flat copy method to the use of objects, at first, only those so-called type-forms were employed which were supposed to develop the technics of the subject. The theory was that this, because it emphasized exactness, contributed most to "mental discipline." Figures, forms, and models were chosen with this end in mind, and but little consideration was given to a study of form in its relation to function. Most objects chosen had no apparent immediate function, and therefore the subject was but one degree removed from its first state. But now drawing is used as a means of getting at the meaning of things. It is a direct mode of studying the relation of form and function, and it therefore happens

that the meaningless, unrelated objects, and the so-called type-forms, are gradually disappearing from the drawing lesson.

The past decade presents an instructive parallel in the changes taking place in the teaching of mathematics, especially arithmetic. There has been a vast amount of ingenuity displayed in the use of objects as a basis for work in number. It is the first step removed from the old gymnastics with arithmetical formulas. This particular brand of textbook seeks by means of blocks of wood, geometric figures, and other objects having definite ratios to each other, to ring in all the changes that are possible in the study of quantitative relations. Since the children do the work by handling objects and figures which have a foreordained reciprocal relationship, they soon acquire a prodigious facility in solving all sorts of problems of the usual stereotyped kind. Some of the later books, too, have taken a step in the right direction by presenting a consistent series of problems growing out of the study of some industrial or commercial topic. Most of the authors being good teachers, their books have much to commend them in their suggestiveness as to method, and as texts for reference they are valuable also.

Type-Forms in Number Work

But these arithmetic-makers have gone just as far as anyone can in the direction of textbook-making in this subject. Neither these gentlemen nor any others can ever make, on the commonly accepted plan, a textbook in arithmetic suitable for general class use that will be abreast of the best pedagogic thought. They are the last of their race; they will have no successors, for the same reason that the drawing-book makers of a generation ago have no descendants living in our time. Textbooks for class use in arithmetic belong to the day when the school curriculum was represented by an aggregation of unrelated topics. They have no place, except as a kind of dictionary or reference work, in a school where the course of study is used as a means of organizing the life of the pupils. This does not mean that mathematics will become of less moment in the schools than it has been heretofore. We shall have more of it and a better kind — it is to be hoped, real mathematics.

End of Text-book Making

Mathematics is simply unthinkable apart from the quantitative

aspect of the things studied. It can not be separated from the study of an object any more than the object can be divested of its color. That is, the quantitative relations of an object are inherent, and they can be studied only through the application of some form of mathematics. Now, so long as the objects studied in school were merely an assemblage of convenient forms with no organic connection with each other, we could afford to play with that semblance of mathematics found in the machine-made textbook. But we have never had much real mathematics; we have had an endless deal of textbook arithmetic. The proof of this is that while there are plenty of people who know the "Tables" and the definitions, and to a lesser extent the rules, all of which the textbooks *did* teach, there is not one in a hundred who has not had his mathematical sense blunted, if not destroyed, by the omission of just that particular thing which the textbooks cannot teach — namely, mathematics.

Place of Mathematics

Mathematical Sense Destroyed

Most of the later textbooks justly emphasize the necessity of imaging in number work through the use of objects. But the trouble is that the objects generally selected have no earthly interest, in themselves, for the pupils. This at once reduces the exercises given to the basis of "number for number's sake." They are doing precisely what the drawing teachers did in using the "type-forms" in developing "drawing for drawing's sake." It differs not a whit from teaching "language for language's sake," "reading for reading's sake," and, in general, everything else that is taught for the sake of the process. Of course, the process is important; it is the process that determines the ease and the economy by which a thing is done. But the process always has a fixed and unalterable place in our thinking, and it is this fact that the machine-made arithmetic ignores. Underlying the process is the logic of thinking, and the process is but the tangible form through which that logic is expressed. The arithmetic-makers invert the matter; practically, every problem introduced is given for the sake of the process involved; they give the least possible attention to the all-around development of a subject which

Uninteresting Objects Used

Nature of a Process

is necessary to show what its mathematical relations are, and without which showing all mathematical processes are meaningless; whereas it is just such a development of the subject that should be emphasized above everything else. This is the way PROCESS always originates. Somebody in his thinking finds that there are certain quantitative relations that must be determined. Through the necessity of his thinking, *a* process, finally *the* process, is evolved, and the image that lacked clearness in the beginning, so far as its quantitative relations are considered, is now cleared up. Now, the machine-made arithmetics are almost wholly composed of a transcript of these processes, thoroughly devitalized through their separation from the natural conditions that gave them birth, and classified into certain groups, accordingly as they involve division, subtraction, decimals, percentage, and so forth. It is true that the later textbook-makers have endeavored to clothe these skeletons of dead thought with some rags and tags of subject-matter; but, like the figure once so familiar in our grandfathers' cornfield, the dry stuffing sticks out at every joint, and the machine-made textbook in arithmetic stands today as the scarecrow of every schoolroom.

Study of Processes Dominates

One false step always leads to another. To teach the processes in arithmetic (or any other subject), when they are not the outgrowth of a natural and immediate demand, is at best a stupid business and well-nigh impossible. Hence, in an attempt to meet this difficulty which they have artificially created, the textbook-makers have had to take a second unpedagogic step by introducing almost endless problems of a like kind to secure repetition. They hope by much iteration and drill to fix the processes in mind, ignoring the fact that the repetition of a meaningless thing, being in itself senseless, is disastrous to actual thinking.

Bad Pedagogy

Repetition in itself is as hateful to children as bad medicine. This has led to the invention of more tricks to beguile the pupils into thinking they are really doing something else; it has given occasion to more sugar-coating of pills, that the real thing may not nauseate them, than can be found in the teaching of any other subject. Children who

Bane of Repetition

would gag at the thing itself are now charmed with the tricks. Teachers are enabled to endure from year to year because of the novelties that are annually introduced which vary the monotony. In fact, one of their chief concerns at the county institute and summer school is to find out, for example, the latest fashions in long division and the spring styles in multiplication of fractions.

A Misguided Effort

The most awful dose of machine-made arithmetic gotten up apparently for "drill for drill's sake," that has been let loose lately upon hapless children is now being prepared by "Forty Teachers" for the schools of one of our large cities. So far as one can discover from the advance sheets of these exercises, the work is illumined by scarcely a ray of pedagogic insight. There was great outcry a while ago because some teachers favored the reintroduction of corporal punishment into the schools. This was bad enough, but I would almost as soon have every youngster soundly bastinadoed every week, and then turned out into the parks for the rest of the day to recuperate, as to have him sit through the toilsome days under the arithmetical régime that is now being prepared for him. There are some things that are worse for the intellect and morals than a body-beating. If the work of these "Forty" collaborators were intended to be a cyclopedic dictionary of criminal antiquities in psychology and pedagogy, to be kept in a glass case under lock and key along with thumb-screws, it might have some value; but as a modern textbook it is nothing less than a municipal calamity.

Arithmetic the Center of Dread

The machine-made textbook-makers deserve credit for one thing: through the lapse of years, and by dint of incessant effort, they have succeeded in shoving the subject into such prominence as to keep it uppermost in everybody's mind. The thoughts of teacher, child, and parent all revolve around this center, not with a common affection, but in a common dread. Those who can easily master the tricks are regarded prodigies; others are doubtful or dull. The part it has played in the promotion of pupils has caused incalculable wrong simply because it is not a true measure of what we want in a human being.

Sometimes it is urged that we have too much of arithmetic;

but the ability of most people in the use of the subject scarcely indicates that they have been over-taught! How many years, perhaps centuries, of school life are wasted every year in this country by the multiplied discussions upon this and similar points, not even mathematics itself can tell.

Too Much Arithmetic

Shall we have arithmetic in the first grade or not? Like every other process, it depends upon the *thinking* which we have. Look to the *thinking,* then, for the answer. Children of that age when not in school do excellently a good many things that involve estimating, measuring, and counting. They naturally acquire and control these means to some extent in carrying forward some aspects of their thinking. If the first-grade pupils have work in school, therefore, which actually involves thinking, we then cannot put arithmetic out of the grade by "act of Parliament." We might as well try to legislate away a lobe from their brains. Mathematics is implied and understood to be necessary in what we are talking about, namely, *thinking.* This remark is not intended to make an opening through which the machine textbook-maker may run in a lot of his artificial forms and models to be used as subjects of thought; for the purposes of thinking, none of his tricks are half so interesting as dominoes or dice.

How Much Arithmetic?

We have here, then, the reason why the machine-made textbook in arithmetic cannot do the work in the schools needed in mathematics. No author can foretell just what the thinking will be, nor how much there will be. Nobody can tell this except *the teacher and child as they work together.* This is the way the mathematicians determine how much and what kind of mathematics they will use in a given day or year — they are not trying to get through a machine-made book — and this is the way the child and the teacher must determine it. Whether he shall know the numbers from one to ten in the first grade is an irrelevant question. Why are we so scary about large numbers for small children? A child of the first grade who travels from Chicago to New York on the railroad has a better notion of a thousand miles than he has of ten sheep or eight bushels that

Machine Textbook and Thinking

Large Numbers and Small Children

he has never seen. It is all a matter of actual *thinking*. We formerly made the same mistake about the use of words which were classified into short, medium, and long according to the length of the child. But nowadays the child learns the long German, Russian, and Polish names of his seatmates with much greater facility than he does the short monosyllables with which we try to educate him. It is all a matter of *thinking*, as to whether the form side of any subject shall give trouble or not.

Knowing Ten

When we set out to teach all there is in a number, as ten, for example, there are two things that should be remembered: first, it is never needed, and, second, it cannot be done. We shall only need it so far as we meet things which we wish to consider in such groups; and these groups will have to be made one by one as the necessity arises. You may be able to group everything you have seen in tens or in its subdivision; but if you will look out of my study window, I will show you a group of objects, and you will not be able to tell me whether it contains seven or nine or thirteen until, like a child, you begin all over again and count them up. This is a question quite apart from that of committing to memory all the formulas which express the combinations of numbers within ten; that is entirely a question of language, and it should be measured by its merit as a language lesson and according to the principles that here are being discussed.

The Psychological Need

Much of the confusion concerning number work can be charged up to those who have written upon its psychology. They have generally devoted themselves to a consideration of how the mind moves through the processes, ignoring or forgetting the fact that in practical school work the *movement* is the thing that is missing, and that it is absent because there is a lack of thought-stuff to start it. The psychological necessity for honest and abundant thought-material is the fact above all others that needs to be driven home to the consciousness of teachers. With plenty of this material at hand, with freedom to work, and with a motive to be realized, there need be neither difficulty nor mystery as to the place and part that mathematics shall take in education.

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